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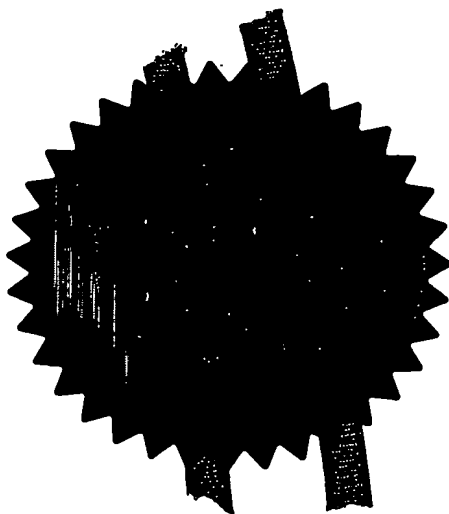
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Signed *Am. B. Jones*

Dated 24 June 2004

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Patents Form 1/77

Patents Act 1977  
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THE PATENT OFFICE  
25 APR 2003  
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25APR03 E802779-1 C71306  
P01/7700 0.00-0309452.1

## Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
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## 1. Your reference

TBS/GIBBS -D80

## 2. Patent application number

(The Patent Office will fill in this part)

25 APR 2003

0309452.1

## 3. Full name, address and postcode of the or of each applicant (underline all surnames)

08443731001

Patents ADP number (if you know it)

GIBBS TECHNOLOGIES LTD,  
LA MOTTE CHAMBERS,  
ST. HELIER,  
JERSEY, CHANNEL ISLANDS JE1 1BJ

If the applicant is a corporate body, give the country/state of its incorporation

BRITISH VIRGIN ISLANDS

## 4. Title of the invention

AMPHIBIOUS VEHICLE STEERING

## 5. Name of your agent (if you have one)

T. BAIN SMITH,

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

WICKENS MANOR,  
CHARRING,  
NR. ASHFORD,  
TN27 0DT

Patents ADP number (if you know it)

08268229001

## 6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)Date of filing  
(day / month / year)

## 7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

## 8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

See note (d))

Yes

## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

5

Claim(s)

2

Abstract

1

Drawing(s)

4

only 8

10. If you are also filing any of the following, state how many against each item.

Priority documents

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Translations of priority documents

—

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

1

Request for preliminary examination and search (Patents Form 9/77)

1

Request for substantive examination (Patents Form 10/77)

1

Any other documents (please specify)

Fee Sheet

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

25.4.03

12. Name and daytime telephone number of person to contact in the United Kingdom

T. BAIN SMITH

0208 688 8318 (M)  
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available. In this context, it should be noted that the marine steering is self-centring. In the absence of any control input or restraint of movement, passage of water through the jet steering nozzle will tend to centre the nozzle.

5 It is an object of the invention to provide a steering system for a planing amphibian in which the steering system is balanced, so that power assistance to the road steering matches the power assistance required to overcome the self centring tendency of the marine propulsion unit running at high speed. Another object is to reduce the bulk of parts of the steering assembly in the region between the front wheels, which have to retract to  
10 reduce water resistance in a planing amphibious vehicle.

According to the invention, there is provided an amphibious vehicle having retractable wheels and a planing hull, a marine propulsion unit, front wheels arranged to be steered by means of a power assisted transversely mounted element linked by means of a  
15 link for each wheel, the links arranged to fold upwards on retracting the wheels, an actuating rod mounted to said element, the rod arranged for transverse movement, and a flexible coupling means connecting said actuating rod to a steerable part of the marine propulsion unit, so that transverse movement of said element steers the part of the marine propulsion unit.

20 Preferably, both road and marine steering systems may be operated simultaneously. The transversely mounted element may be a rack and pinion steering system. The coupling means is preferably a push-pull cable and a bell-crank means attached to the actuating rod. The push-pull cable arrangement, comprising a cable slidable in a sleeve, is readily  
25 arranged so as to fit between body members and the vehicle power train with a minimum bending radius of 150mm. In one embodiment, the cable is between 12 and 13mm in diameter, whilst the outer sleeve of the cable is between 15 and 17mm in diameter.

The steering system may be readily adapted to a steering system comprising more  
30 than one steered front axle. It could also be adapted to a marine propulsion system comprising more than one marine propulsion unit.

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An embodiment of the invention will now be described by way of example with reference to the following drawings in which:

Figure 1 is a perspective view from above and behind, of the front wheel steering  
5 arrangement of an amphibian with retractable wheels according to the invention;

Figure 2 is a side view of one front wheel arrangement of the amphibian of Figure 1 in road mode, with the front wheel removed for clarity;

10 Figure 3 is a side view of the front wheel arrangement of Figure 2, in the wheel retracted position in marine mode; and

Figure 4 is a plan view of a marine propulsion unit of the amphibian of Figure 1, as steered  
15 by the steering arrangement of Figure 1.

In the drawings, Figure 1 shows on the left the front wheel hub assembly 2 with brake disc 4 and brake caliper 6. The hub assembly 2 is mounted to upper and lower wishbones 8 and 9, which enable piston and cylinder arrangement 12 to raise the front wheel from the position shown in Figure 2 to that shown in Figure 3. In doing so, link 14  
20 (there is the same arrangement on the other side, shown at 14') folds upwards to the position 14'' shown in broken lines in Figure 1. (The folded position 14'' is shown for link 14', for clarity). Figure 3 also shows part of the hull 10 to which wishbones 8 and 9 are mounted via a mounting plate (omitted for clarity). The hull 10 has a planing bottom 11.

25 Coupled to links 14 and 14' is power assisted transversely mounted steering rack unit 16, actuated by a pinion in housing 18; which in turn is actuated by an inner steering column on axis 20, and finally by a steering wheel 22, shown diagrammatically at a severely reduced scale for clarity.

30 The rack movement is some 114mm lock to lock, whilst the steering wheel has 2.3 turns from lock to lock. Mounted to rack arm 24 is bracket 26, to which is in turn mounted link rod 28; to the other end of which is mounted bell crank 30. Crank 30 is pivoted about pivot 32, and coupled to push-pull cable 34; which is slidably mounted in flexible casing

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or sleeve 36. The coupling between rack arm 24 and bell crank 30 is such that rod 28 is in front of steering column 20. This ensures economy of space.

At the rear of the vehicle is marine propulsion unit 40, shown in Figure 4, which  
5 has a steering nozzle 42 pivotally mounted to propulsion conduit housing 44 at 46. Bolted to said nozzle is steering arm 48, to which the push-pull cable is coupled. Sleeve 36 is fixedly secured at 50 to flange 52 of housing 44. Sleeve 36 is 15 to 17mm in diameter, whilst cable 34 is 12 to 13mm in diameter. The cable and sleeve are arranged in the vehicle with a minimum bending radius of 150mm. A reversing bucket may be fitted to the  
10 steering nozzle, as is known in the marine engineering art.

It should be noted that further refinements may be made to the steering system described above without departing from the essential inventive concept. For example, the system is particularly suited to be adapted to a road steering system using "steer by wire";  
15 that is, not having a mechanical linkage between the steering wheel and the transversely mounted steering element. Such a system would be particularly advantageous to an amphibian, in that the bulkhead ahead of the driver would be more easily sealed against passage of water without a conventional steering column passing therethrough. The power assisted steering system may be hydraulic, hybrid hydraulic/electric, electric, or magnetic.  
20 The input to the marine steering system could be taken from a steered rear axle. This would, however, require some means of control which accounted for the fact that most rear wheel steering systems sometimes steer the rear wheels out of phase with the front wheels; and sometimes in phase with them.

25 Where two or more marine propulsion units are used, their steering nozzles may be mechanically linked to ensure that they turn in phase with each other. Such a linkage may have some geometry comparable to Ackermann geometry for road steering. Where two or more front steered axles are used, they may both have hydraulic cylinders to steer their respective wheels. With two steered front axles and two marine drives, a cable could be  
30 taken from each steered axle to a respective marine drive.

The fixing of the cable sleeve to the jet flange described above is a simple and cheap solution. It may be preferred to fix the cable sleeve to a jet flange by means of a

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bracket and locknuts, thereby allowing longitudinal adjustment of the cable sleeve; as is known in the marine engineering art.

5 The steering system described offers a fixed ratio between road and marine steering, which is fixed at the design stage by the lengths of the arms on the bell crank. The drawback of such a fixed ratio is considered to be outweighed by the system's compactness, simplicity, and light weight; each of which are particularly helpful where retractable wheels are fitted.

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Claims

1. An amphibious vehicle having retractable wheels and a planing hull, a marine propulsion unit, front wheels arranged to be steered by means of a power assisted transversely mounted element linked by means of a link for each wheel, the links arranged to fold upwards on retracting the wheels, an actuating rod mounted to said element, the rod arranged for transverse movement, and a flexible coupling means connecting said actuating rod to a steerable part of the marine propulsion unit, so that transverse movement of said element steers the part of the marine propulsion unit.
2. An amphibious vehicle according to claim 1, wherein both road and marine steering systems may be operated simultaneously.
3. An amphibious vehicle according to claim 1 or claim 2, wherein the transversely mounted element is a rack and pinion steering system.
4. An amphibious vehicle according to any of the above claims, wherein the coupling means is a push-pull cable.
5. An amphibious vehicle according to claim 4, wherein the push-pull cable is coupled to the actuating rod through a bell crank means.
6. An amphibious vehicle according to claim 5, wherein the bell crank means is connected to the transversely mounted element by means of a rod means mounted in front of a steering column.
7. An amphibious vehicle according to any of the above claims, wherein more than one front steered axle is fitted.
8. An amphibious vehicle according to any of the above claims, wherein more than one steered marine propulsion unit is fitted.

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9. An amphibious vehicle as herein described or as illustrated in any one or more of Figures 1, 2, 3, or 4.

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## ABSTRACT

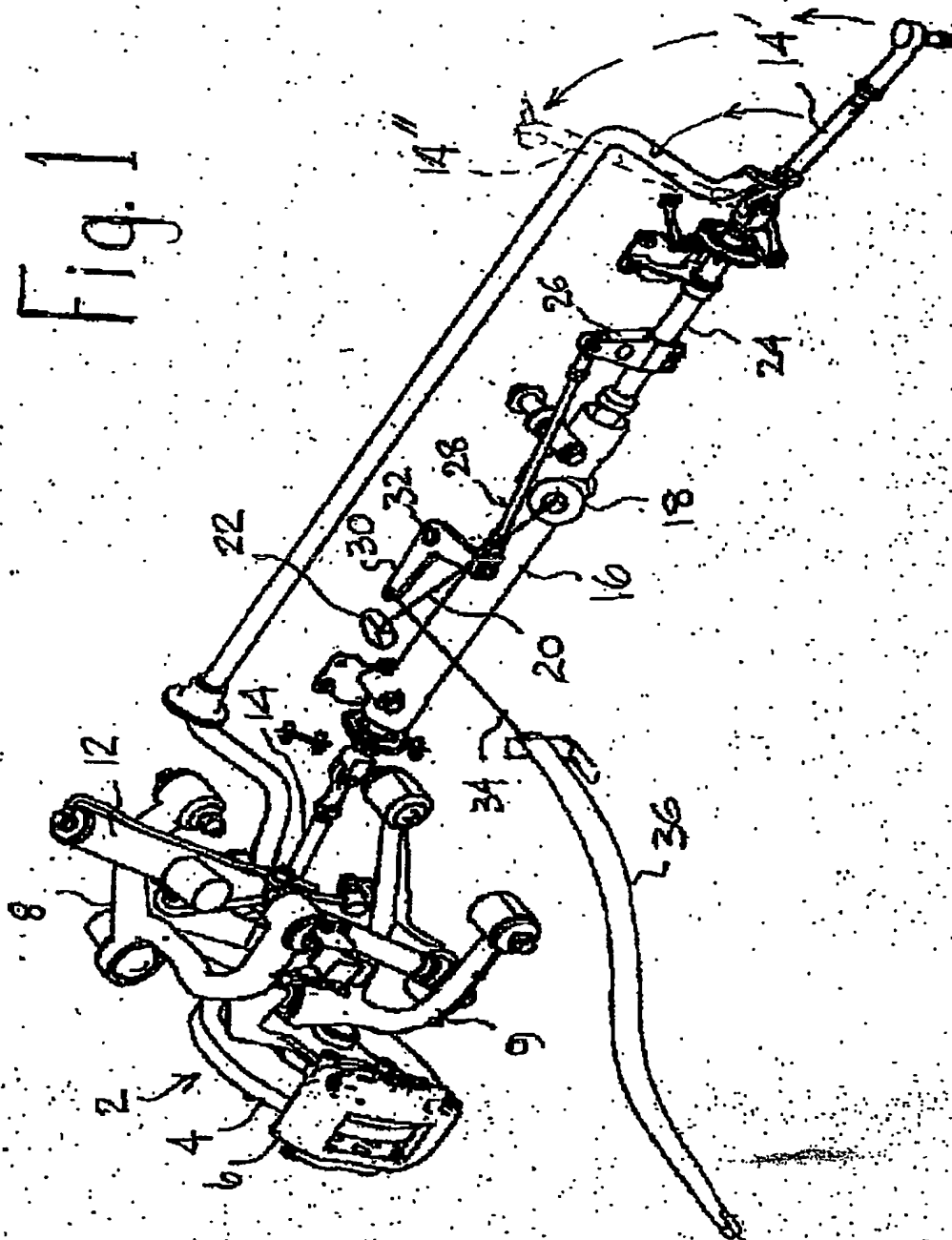
Amphibious vehicle cable steering system

(fig. 1)

An amphibious vehicle has retractable wheels (figs. 2 and 3) attached to hubs 2, and a planing hull (10, 11, fig. 3). Front wheels are arranged to be steered by a power assisted transversely mounted element 16, which may be a rack and pinion unit. The element is linked to the wheels by links 14, 14', which fold up to position 14'' when the wheels are  
5 retracted. Actuating rod 28 is mounted to said element, and arranged for transverse movement. A flexible coupling means, such as cable 34 and sleeve 36, connects rod 28 to a steerable part (42, fig. 4) of a marine propulsion unit, to effect marine steering. Road and marine steering may be operable simultaneously. More than one front steered axle, and/or marine propulsion unit, may be fitted. The steering system is readily adapted to all kinds of  
10 power assisted steering, and also to "steer by wire".

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Fig. 1



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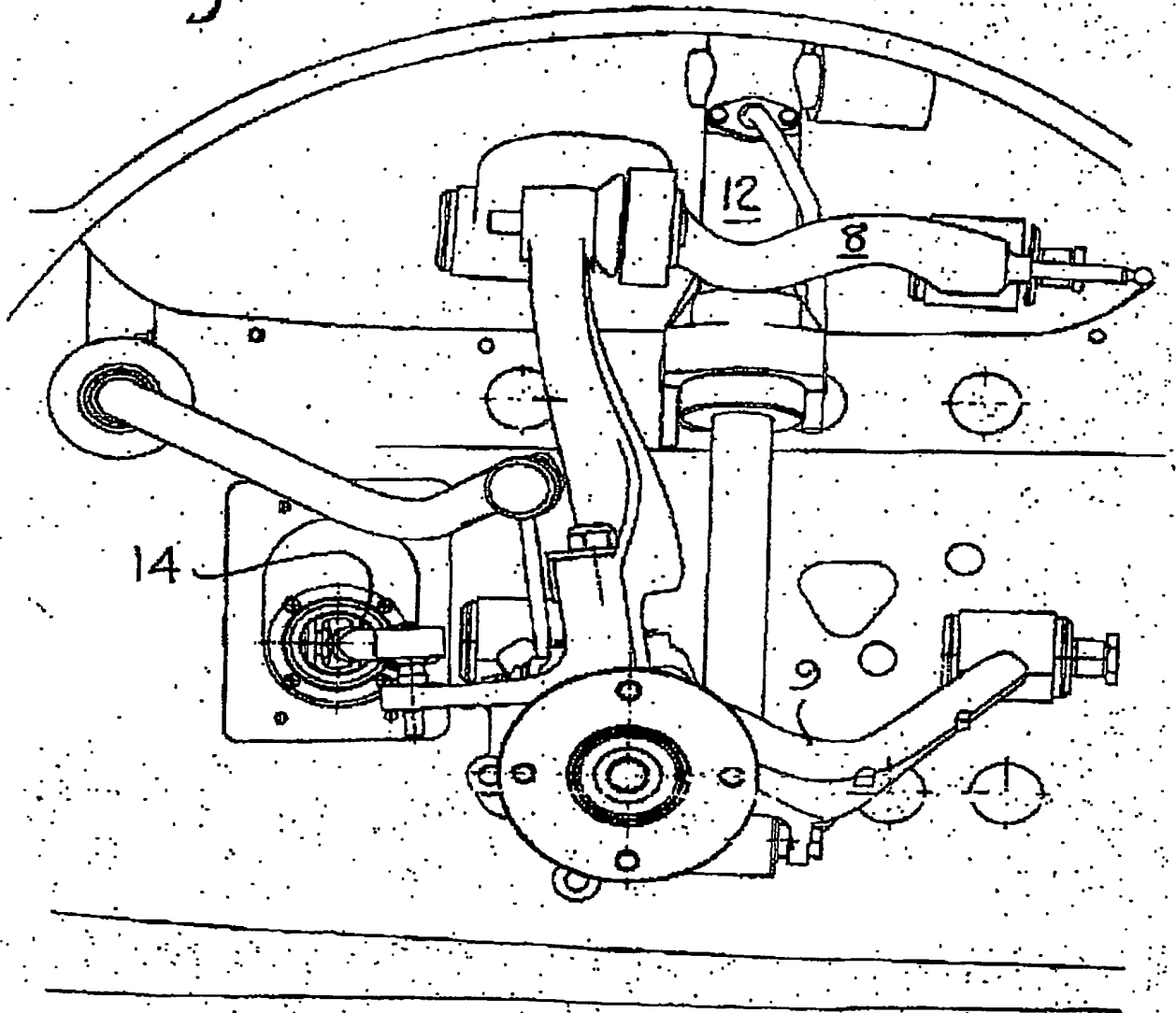
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Fig.2



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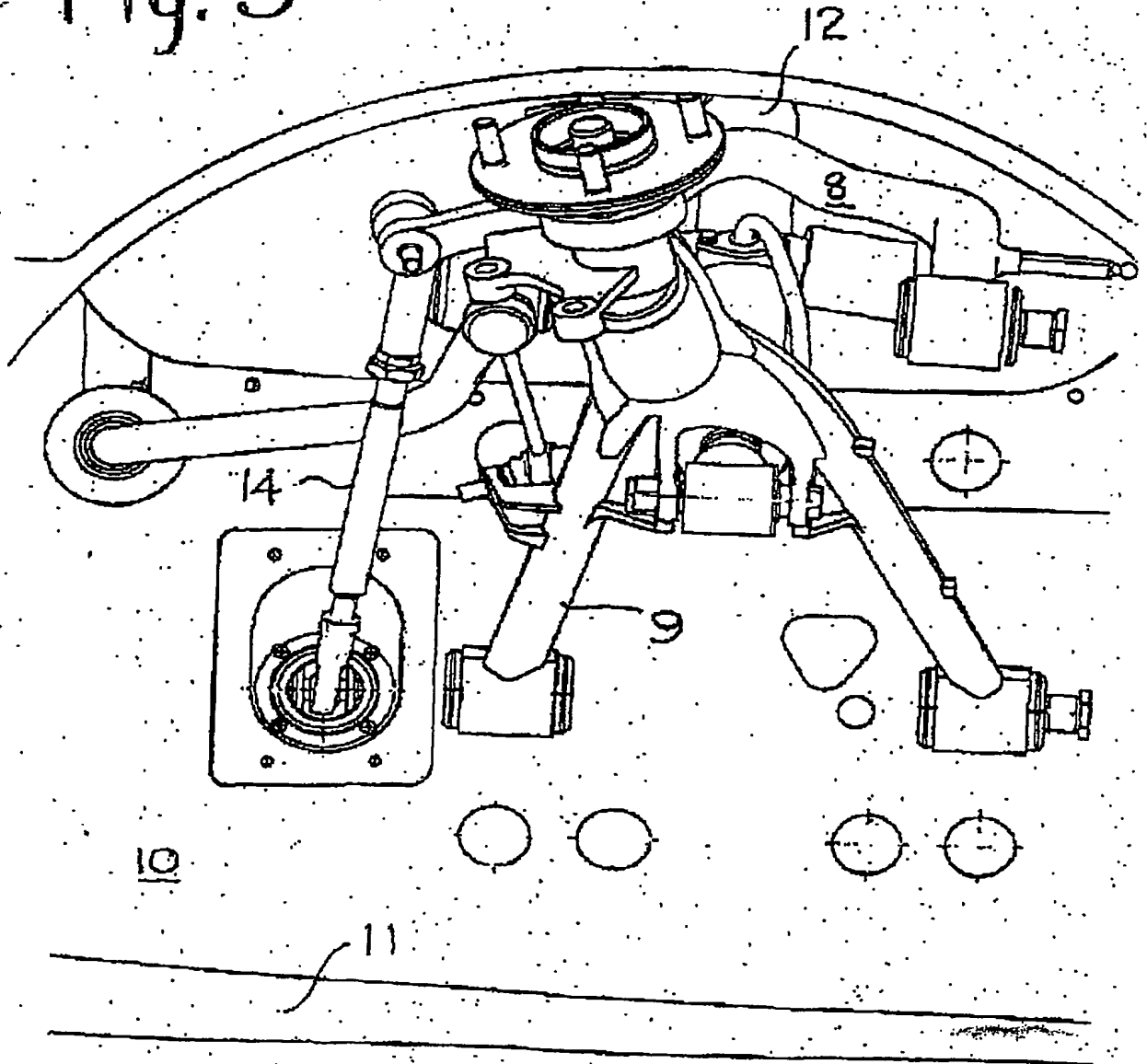
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Fig. 3



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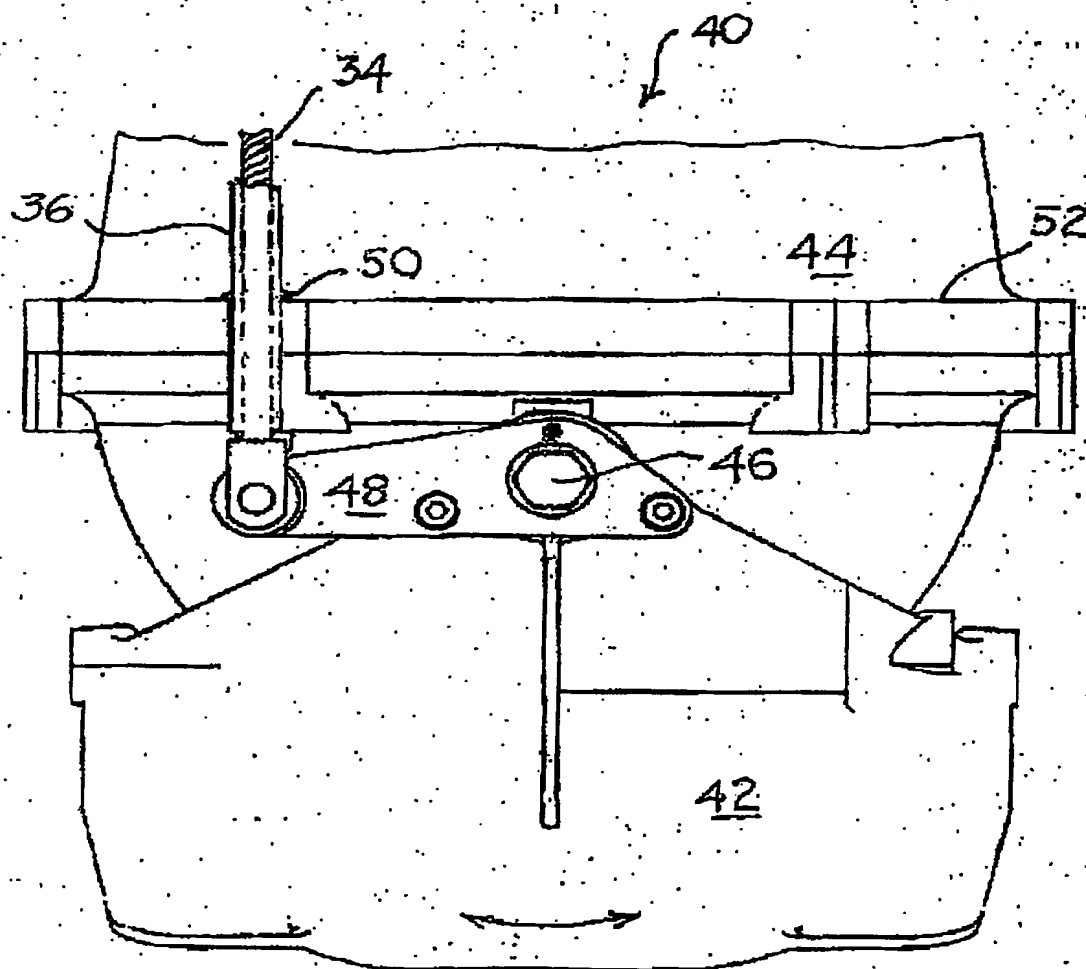


Fig. 4

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